

# Illustrated catalogue of Pericopina (Lepidoptera, Erebidae, Arctiinae) in the Museum of Nature Hamburg – Zoology

Simeão de Souza Moraes<sup>1,2</sup>, André Victor Lucci Freitas<sup>2</sup>, Karina Lucas Silva-Brandão<sup>3</sup>

1 *Museu de Diversidade Biológica, Universidade Estadual de Campinas, Rua Monteiro Lobato, 255, Campinas, SP, CEP 13083-862, Brazil*

2 *Departamento de Biologia Animal, Universidade Estadual de Campinas, Rua Monteiro Lobato, 255, Campinas, SP, CEP 13083-862, Brazil*

3 *Leibniz Institute for the Analysis of Biodiversity Change, Museum of Nature Hamburg - Zoology, Martin-Luther-King-Platz 3, 20146 Hamburg, Germany*

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Corresponding author: Simeão de Souza Moraes (simeao\_moraes@yahoo.com.br)

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## Abstract

Revisionary studies and taxonomic catalogues are valuable resources for compiling biodiversity knowledge because they offer essential information for the identification and use of scientific names, enabling a biological system to be convincingly described in detail and with clear scientific nomenclature. In addition to the updated and standardized use of scientific names, data on geographic distribution, ecological relationships, host plant use, and other topics may be included in taxonomic catalogues to assist in closing knowledge gaps. Here, we offer an illustrated inventory of the pericopine tiger moths that have been deposited in the Lepidoptera collection at the Museum of Nature Hamburg - Zoology. The classification of the group has undergone significant changes in recent decades, and these updates are reflected in this catalogue. Additionally, it provides information regarding the geographical range of the moths, their associations with specific host plants, the differences between males and females in terms of physical characteristics, and their participation in mimetic rings.

## Key Words

Arctiini, Biological collections, Sexual dimorphism, tiger moths

## Introduction

Estimates suggest that the Neotropics include at least 30% of the wide array of lepidopteran species (Aguiar et al. 2009). Nevertheless, the region undeniably contains a substantial number of undiscovered species, especially inside hidden groups and small moth populations (Moraes et al. 2021, 2023). One emblematic example of neotropical species diversity is found in the subfamily Arctiinae, which comprises the tiger moths. This subfamily encompasses over 11,000 species (Watson and Goodger 1986), accounting for approximately 6% of the world's lepidopteran diversity (Goodger and Watson 1995). The taxonomic history of Arctiinae remained obscured for the past centuries, mainly due to distinct lineages with high morphological resemblance (Weller et al. 2009). These

superficial similarities were often used to establish classification systems that resulted in unnatural groupings. Additionally, several authors erected or used artificial groups to classify species that could not be accommodated by pre-existing groupings (e.g., Microarctiinae: Seitz 1913; Murzin 2003; Microarctiini: Pinhey 1975; Hypsidae [Noctuidae:Aganainae]: Hampson 1918), further contributing to taxonomic confusion within Arctiinae.

Four groupings are currently recognized, Arctiini, Lithosiini, Syntomini and Amerilini (Kitching and Rawlings 1998; Jacobson and Weller 2002; Fibiger and Hacker 2005; Fibiger and Lafontaine 2005; Dowdy et al 2020). While Syntomini represents a comparatively small lineage of wasp-mimicking moths, Arctiini and Lithosiini represent the most diversified lineages, with a worldwide distribution.

Tiger moth caterpillars have primary and secondary setae that provide physical and chemical protection against predation. Additionally, the strong association between tiger moths and their larval host plants, facilitated by plant secondary chemical compounds, is noteworthy even in a taxonomic investigation, as it provides excellent taxonomic indicators for species categorization. Larvae of Arctiini forage on host plants that include members of the families Asteraceae, Boraginaceae, Apocynaceae and Fabaceae (Scoble 1992), all known for the presence of pyrrolizidine alkaloids (Silva-Brandão et al. 2021). This list is incomplete, as there are many scattered observations of Arctiini feeding on many other families, especially as larvae, where PA sequestration is more limited than in the adults. Several species of Syntomini feed on Asteraceae (Kitching and Rawlings 1998), with some records of species foraging on mosses (Common 1990), algae and fungi (Holloway 1988), or even as detritivore species (Kitching and Rawlings 1998). Larvae of Lithosiini characteristically forage on algae and lichens (Habeck 1987; Covell 2005) and occasionally on bryophytes (Forbes 1960; Holloway 1988). All acknowledged tribes and subtribes have species that are recognised for their ability to accumulate secondary chemical compounds from the plants they inhabit, such as pyrrolizidine alkaloids, cardiac glycosides, cardenolides, sesquiterpenes and polyphenols (Weller et al. 1999; Corner and Weller 2004; Bowers 2009). Both caterpillars and adults utilise these chemicals as mechanisms of unpalatability, which synergistically complement visual colour signals (aposematism) and even ultrasonic sound as deterrents against predation. (Weller et al. 1999; Barber et al. 2022).

Syntomini and Lithosiini, which are commonly considered as closely related to other tiger moths, have never been reported sequestering pyrrolizidine alkaloids (PAs) or cardenolides (Hesbacher et al. 1995). However, they sequester other classes of secondary compounds found mainly in lichens, such as polyphenols, anthraquinones, parentins and vulpinic acids (Hesbacher et al. 1995; Weller et al. 1999). Other compounds, such as pyrazines and other polypeptides, are produced *de novo* (Burdfield-Steel et al. 2018).

In Arctiini, PA sequestration is widespread, being a potential synapomorphy for the tribe (Weller et al. 1999; Corner and Weller 2004). Sequestration of PAs has been documented in both adults and larvae, and chemical compounds are typically found also in the chorion of eggs, the integument of adults, the hemolymph, the larvae, and the larval setae (Corner and Weller 2004), or released as a secretion through thoracic glands in adults of Arctiina, Pericopina, Ctenuchina and Phaegopterina (Dhetier 1939; Moraes pers. obs.). Some species of Ctenuchina and Phaegopterina also release fluids from the junction of the trochanter and the coxae (Moraes pers. obs.). These compounds are transferred from immature stages to adults (Hartmann 2009), biparentally to eggs (Dussourd et al. 1988; Dussourd et al. 1991), and from males to females, during courtship (Dussourd et al. 1991; Hartmann et al. 2004). The unpalatability conferred by these chemical compounds allows the Arctiini to occupy niches that are little explored by other groups of lepidopterans (Wagner 2009), and although much is

currently known about PA sequestration and its evolutionary and behavioural implications, studies are often based on a few species (e.g. *Arctia caja* (Linnaeus, 1758) and *Utetheisa ornatrix* (Linnaeus, 1758)), with almost no studies addressing diverse Neotropical groups such as Cisthenina, Pericopina and Phaegopterina.

Traditionally, the concept of Arctiini encompasses the subtribes Arctiina, Ctenuchina, Euchromiina, Calimorphina, Phaegopterina and Pericopina (Forbes 1939, 1960; Ferguson 1985; Kôda 1987, 1988; Kitching and Rawlings 1998; Weller et al. 2009; Moraes et al. 2021, 2022). Pericopina stands out by having the majority of its species with neotropical distribution and some species distributed in the USA (Moraes et al. 2022). The adults are characteristically colourful and/or show an iridescent pattern (e.g. species of the genera *Ctenuchidia* Grote, *Hypocrita* Hübner, *Calodesma* Hübner, *Crocomela* Kirby and *Composia* Hübner), taking part in mimicry rings with other moths (e.g. Dioprinae, Geometridae, Castniidae) and butterflies (e.g. Nymphalidae, Papilionidae) (Hering 1925; Watson and Goodger 1986; Lamas and Grados 1996; Simmons 2009; Moraes et al. 2021, 2022). Many species are diurnal, sexually dimorphic and aposematic, with some groups showing an extreme sexual dimorphism (e.g. *Dysschema*) (Moraes et al. 2021). For some species in Pericopina the males are sampled with light traps during the night, while the females have a diurnal habit and are apparently rare or difficult to find (e.g. *Dysschema amphissa*, *Euchlaenidia trancisa*) (Travassos Filho 1947; Moraes pers. obs.). This variation on flight period between males and females, associated to their sexual dimorphism, resulted in descriptions based on only one of the sexes and, not rarely, females and males were described as different species, contributing to the taxonomic chaos in Pericopina (Travassos Filho 1947; Lamas and Grados 1996; Moraes et al. 2017, 2021).

The Pericopina collection rarely yields significant results in terms of specimen count, which contributes to the low representation of most species in collections (Moraes pers. obs.). This makes the Pericopina a focal group for museomics studies, particularly for the rare or under-sampled species, despite the incredible diversity of wing patterns that attract butterfly collectors. Here we present an illustrated catalogue of the Pericopina species deposited at the Museum of Nature – Zoology in Hamburg, with notes on taxonomy, distribution and natural history, including details on host plant records and involvement in known and potential mimicry rings.

## Material and methods

### Taxonomic sampling

The photographed specimens are deposited in the Lepidoptera collection of the Museum of Nature Hamburg – Zoology (ZMH). Most of them were collected between 1930 and 1970 (Table 1). The photographs were captured with the Passport Portable Digital Imaging System manufactured by Visionary Digital (DUN Inc., California,

USA). The system comprises a Canon EOS 6D camera, together with several macro lenses such as the Canon MP-E 65 mm, and a Canon Speedlite lighting system.

## Results

### Species list

#### *Calodesma* Hübner

##### *Calodesma maculifrons* (Walker, 1865)

Fig. 1A

**Remarks.** *Calodesma maculifrons* has highly distinctive wing patterns in comparison to other species within the same genus, but lacks sexual dimorphism. Its forewing pattern has an orange background pattern, a yellow post-discal cell maculae, and a submarginal band consisting of parallel yellow stripes on a black background; the hindwing has orange background, the costal and the outer margin black, and parallel yellow stripes on the outer margin. Moths from other families share the same wing patterns, for instance *Mapeta xanthomela* (Pyrilidae), *Pseudatteria volcania* (Tortricidae), *Pseudomennis bipennis* (Geometridae), *Pyromorpha radialis* (Zygaenidae), *Phostria lithosialis* (Crambidae), *Oricia homalochroa* (Notodontidae), and some butterflies in the genus *Mesene* from Central America (e.g. *Mesene margaretta*) (Riodinidae), suggesting a mimicry ring. Some specimens may show polychromatism with fore and hindwings entirely black and yellow parallel stripes on the outer margin.

**Material examined.** 1 male, Guatemala.

#### *Chetone* Boisduval

##### *Chetone isse* (Hübner, [1831])

Fig. 1B

**Remarks.** *Chetone isse* is a species that does not exhibit sexual dimorphism and has a dark tiger-pattern which is quite different from that dominant in the Atlantic Forest. Some specimens might show polychromatism on the hindwings, in the black submarginal band, which has led to the description of *Pericopis decisa*, later considered a synonym by Buttler in 1875 (Lamas 2017).

**Material examined.** 1 male, Brazil, Rio de Janeiro; 1 male, Brazil, Santa Catarina; 1 female, Brazil, Rio Grande do Sul.

##### *Chetone kenara* (Butler, 1871)

Fig. 1C

**Remarks.** *Chetone kenara* is a non-sexually dimorphic species with a dark tiger-pattern mimicry coloration quite different from other Amazonian aposematic butterflies.

**Material examined.** 1 male, Venezuela.

##### *Chetone phaeba* Boisduval, 1879

Fig. 1E

**Remarks.** *Chetone phaeba* is non-sexually dimorphic species with a mimicry coloration resembling some butterflies, occurring in the same region, such as *Heliconius erato emma*, *Heliconius melpomene aglaope*, *Heliconius demeter demeter*, *Heliconius xanthocles melittus* and *Castilia perilla* (Nymphalidae).

**Material examined.** 1 female, Peru, Iquitos.

#### *Composia* Hübner

##### *Composia credula* (Fabricius, 1775)

Fig. 1F

**Remarks.** *Composia credula* is non-sexually dimorphic and is distributed mainly in Central America, with records in the islands of Puerto Rico, Jamaica, Cuba and the Dominican Republic. Scant information regarding this species can be found in the literature.

**Material examined.** 1 male, Jamaica.

#### *Dysschema* Hübner

##### *Dysschema amphissa* (Geyer, 1832)

Figs 1G male, 1H female

**Remarks.** This species has a considerable level of sexual dimorphism in terms of its wing pattern. Immature reared by Lauro Travassos and deposited in the MZUSP corroborate the establishment of synonymy between *Episteme amphissa* and *Pericopis vestalis*. Males have a white wing pattern with the forewings (mainly on the costal margin, apical region and posterior margin) and hindwings (submarginal band) showing brown obscured regions. Specimens recently collected in Brazil show this pattern, although the material studied in collections revealed the presence of some individuals whose brown markings on the wings are faded. However, such variation seems to be due to the storage of specimens rather than polychromatism. Females have an orange pattern, similar to that of other *Dysschema* species involved in mimetic rings with several species of Heliconiinae and Ithomiini butterflies (Nymphalidae).

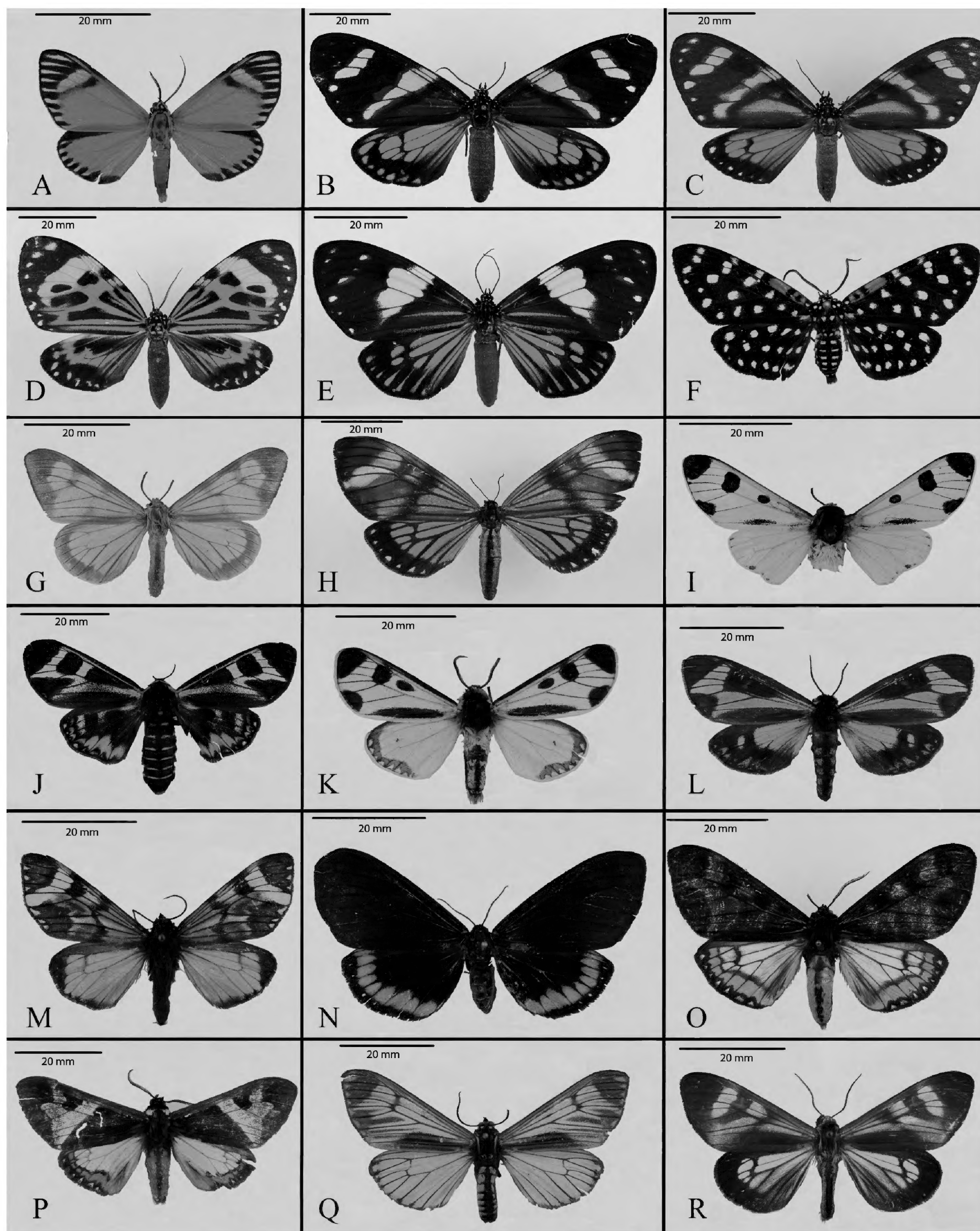
**Material examined.** 2 males, Brazil, Rio de Janeiro; 2 females, Brazil, Rio de Janeiro.

##### *Dysschema boisduvalii* (Hoeven, 1840)

Figs 1I male, 1J female

**Remarks.** Sexually dimorphic species. Males and females show slightly chromatic variation, usually limited to the intensity of red tones on the hindwing spots. Males of *D. boisduvalii* are distinguished from other species associated with this complex (*D. centenaria* and *D. inornatum*) by showing spiniform projections at the base of





**Figure 1.** Habitus of pericopine moths, dorsal view. **A.** *Calodesma maculifrons* (Walker, 1865) (ZMH 0840354); **B.** *Chetone isse* (Hübner, [1831]) (ZMH 0840038); **C.** *Chetone kenara* (Butler, 1871) (ZMH 0840367); **D.** *Netoche histrio* (C. Felder & Felder, 1874) (ZMH 0840040); **E.** *Chetone phaebe* Boisduval, 1879 (ZMH 0840368); **F.** *Composia credula* (Fabricius, 1775) (ZMH 0840355); **G.** *Dysschema amphissa* (Geyer, 1832), male (ZMH 0840048); **H.** *Dysschema amphissa* (Geyer, 1832), female (ZMH 0840049); **I.** *Dysschema boisduvalii* (Hoeven, 1840), male (ZMH 0840352); **J.** *Dysschema boisduvalii* (Hoeven, 1840), female (ZMH 0840353); **K.** *Dysschema centenaria* (Burmeister, 1878), male (ZMH 0840356); **L.** *Dysschema centenaria* (Burmeister, 1878), female (ZMH 0840357); **M.** *Dysschema hilara* (Weymer, 1895), male (ZMH 0840043); **N.** *Dysschema leucophaea* (Walker, 1854), female (ZMH 0840359); **O.** *Dysschema lycaste* (Klug, 1836), male (ZMH 0840045); **P.** *Dysschema marginalis* (Walker, 1855), male (ZMH 0840046); **Q.** *Dysschema neda* (Klug, 1836), male (ZMH 0840047); **R.** *Dysschema picta* (Guérin-Méneville, 1844), male (ZMH 0840044).

the valva, whereas females are distinguished by having the opening of ostium in the middle of the seventh sternite and an enlarged ductus bursae. Based on the similarity of wing pattern, males could participate in a mimicry ring with other similar species in this genus, such as *D. centenaria* (see below) and *D. inominatum*, among others.

**Material examined.** 1 male, Brazil, Rio de Janeiro; 1 female, Brazil, Rio de Janeiro.

### *Dysschema centenaria* (Burmeister, 1878)

Figs. 1K male, 1L female

**Remarks.** Sexually dimorphic species. Males and females show a slightly chromatic variation, on the intensity of red tones on the forewing spots, sometimes absence of the discal spot on the hindwing. Some females, with red spots approximated or fused on the forewing discal region, may show more evident red spots in the submarginal band of the hindwing. Immatures were reared in *Eryngium paniculatum* (Apiaceae) by Achaval (1968) and in *E. eburneum* by Jörgensen (1935), allowing the association between males and females.

In the original description of *D. centenaria*, Burmeister calls attention to the possibility that this species can be just a variation of *D. boisduvalii*. However, the first is externally distinguished from *D. boisduvalii* by having white or yellow scales dorsally on the apex of forewings and ventral surface of the forewings; hindwings with yellow spots on the base; and abdomen ventrally brown. Differences in the morphology of female and male genitalia corroborate the status of distinct species.

**Material examined.** 1 male, Paraguay, Villarica; 1 female, Paraguay, Villarica.

### *Dysschema hilara* (Weymer, 1895)

Fig. 1M

**Remarks.** Sexually dimorphic species with both males and females displaying chromatic variation in their wing patterns. Males have polychromatism with two forms, one with the basal and discal region on the hindwing with reddish tones, and the other with yellow tones. Females show greater variation, both on the forewing and on the hindwing. Some individuals have a predominantly brown hindwing, with a submarginal band with variable colour and length, usually red or yellow; a few individuals may have a yellow colour on the basal and discal region of the hindwing.

**Material examined.** 1 male, Brazil, Santa Catarina, Hansa?

### *Dysschema leucophaea* (Walker, 1854)

Fig. 1N

**Remarks.** Species with a forewing pattern sexually dimorphic, and widespread distribution more concentrated in

north of Central America (Mexico, Guatemala and Nicaragua), with few records for Costa Rica. Males with slightly chromatic variation. The illustrated specimen is very similar to sympatric *Biblis aganisa* (Nymphalidae) and mimicry cannot be discarded. The association between males and females was proposed by Druce (1885) based on specimens with black and red coloration. Laguerre et al. (2014) reported a gynandromorph specimen consisting of right-side male, with the characteristically black and red coloration, however the left side consists of a tiger pattern very similar to *D. aorsa*, suggesting that the female may show two completely distinct mimicry phenotypes. The species was reported foraging on *Vernonanthura patens* (Kunth) H. Rob. (Young, 1981).

**Material examined.** 1 male, Honduras, San Pedro Sula.

### *Dysschema lycaste* (Klug, 1836)

Fig. 1O

**Remarks.** Sexually dimorphic species for the wing pattern, males and females show chromatic variation, and the association between them was proposed by Druce (1884). Females with polychromatism on the hindwings, where the discal band might show variable thickness. Males show variation in the forewings, where the semi-hyaline spots might be well delimited in some specimens or vanished in others; hindwings with variable basal and discal region, whitish or orange; hindwing submarginal band sometimes with orange proximal spots. It is distinguished from the other species in the *D. marginalis* complex by presenting reduced markings on the tegula and patagium, and the posterior margin of the abdominal sternites delineated by brown scales.

**Material examined.** 2 males, Costa Rica, Finca la Loja.

### *Dysschema marginalis* (Walker, 1855)

Fig. 1P

**Remarks.** Sexually dimorphic for the wing pattern. Males might show slightly chromatic variation. This species exhibits a wing pattern that closely resembles that of *D. lycaste*. However, it may be distinguished from *D. lycaste* by its larger male specimens and the presence of dots on the prothoracic collar. *Dysschema marginalis* also has more delineated spots on the forewings and a ventrally yellow abdomen. The morphology of the male and female genitalia does not exhibit discernible distinctions across species, indicating that they constitute a cryptic species complex.

**Material examined.** 1 male, Costa Rica, Guapiles; 1 female, Costa Rica Guapiles.

### *Dysschema neda* (Klug, 1836)

Fig. 1Q

**Remarks.** A sexually dimorphic species, with females usually rare in collections. Females have wing patterns



similar to that of *D. amphissa*. It differs from the latter by having a completely brown head, well-delineated spots on the prothoracic collar, and a darker background on the forewings, with semi-hyaline spots approximated. Kirby (1892) considered males and females as distinct species. Hering (1925) mistakenly associated males of *D. fanatica* with females of *D. neda*.

**Material examined.** 2 males, Brazil, Santa Catarina, Hansa?; 1 male, Brazil, Santa Catarina, New Bremen [Seara municipality]; 1 female, Rio de Janeiro.

***Dysschema picta* (Guérin-Méneville, 1844)**

Fig. 1R

**Remarks.** A sexually dimorphic species. Males show less variable wing pattern, similar to glass wing butterflies, while females have wing polychromatism and show a black yellow and orange tiger pattern. Immatures were reared by Spitz (1931) in *Mikania hirsutissima* and *Senecio brasiliensis*, and by Travassos Filho (1947) in *Vernonia polyanthes* (all Asteraceae). Travassos Filho (1947) made the association between males and females, and documented the polychromatism presented by females, resulting in the establishment of synonyms.

**Material examined.** 1 male, Brazil, Santa Catarina, Hansa?; 1 male, Santa Catarina, New Bremen [Seara municipality]; 1 male, no locality.

***Dysschema sacrificia* (Hübner, [1831])**

Figs 2A male, 2B female

**Remarks.** Sexually dimorphic species, relatively common in collections. The species is widespread in South America, mainly in areas of the Cerrado and in open environments of the Atlantic Forest of Brazil, but with extension in Eastern Bolivia, Uruguay, Paraguay and in the north-centre of Argentina (Chialchia 2009). There is little variation between males and females and both sexes may show a white spot on the forewing in the posterior region of the discal cell. Some males may have the white spots on the submarginal band of the hindwings reduced or absent. Females may show more evident yellow marks on the submarginal band, expanded towards the basal region of the wing.

Several studies recorded the association of immatures with host plants (Bourquin 1931; Biezanko et al. 1974; Chialchia 2009), revealing a highly polyphagous species, with records in Amarantaceae (e.g. *Amaranthus flavus*, *Amaranthus hybridus*), Asteraceae (e.g. *Artemisia absinthium*, *Chromolaena odorata*, *Eupatorium conyzoides*, *Eupatorium inlifolium*, *Helian agnus*, *Lactuca sativa*, *Senecio brasiliensis*, *Vernonia polyanthes*), Myrtaceae (e.g. *Eucalyptus* sp.), Nyctaginaceae (e.g. *Pisonea zapallo*) and Urticaceae (e.g. *Boehmeria caudata*). *Dysschema sacrificia* was introduced in South Africa as a biological control of the invasive weed *Chromolaena odorata* (Asteraceae) (Kluge and Caldwell 1993).

**Material examined.** 1 female, South America; 1 male, Brazil, Santa Catarina; 2 females, Brazil, Santa Catarina; 1 male, Brazil, Santa Catarina, New Bremen [Seara].

***Dysschema subapicalis* (Walker, 1854)**

Fig. 2C

**Remarks.** Sexually dimorphic species, with females larger than males and polychromatic males. The pronounced sexual dimorphism, along with the presence of many colours on the hindwings of males, led to the identification of several species that are actually variations in coloration. Males present some idiosyncratic characteristic, autapomorphic for the species (considering other species in *Dysschema*), such as posterior-proximal projections on the tegumen, similar to those present in other Pericopina genera (*Ephestris* Hübner, *Calodesma* Hübner, *Isostola* Felder, *Hypocrita* Hübner and *Sthenognatha* Felder), spines on the valva, and contorted aedeagus. The females have the openings of the pheromone glands approximated.

**Material examined.** 1 male, Brazil, Santa Catarina, New Bremen [Seara Municipality].

***Dysschema terminata* (Guérin-Méneville, 1844)**

Fig. 2D

**Remarks.** Males and females are sexually dimorphic for wing patterns. Collections carried out at Boracéia Biological Station (Salesópolis, SP, Brazil) allowed the pairing of sexes (Moraes et al. 2017). Additionally, handwritten notes by an unknown author were found at the Smithsonian Natural History Museum, highlighting the possibility that *D. terminata* was the female form of *D. fantasma*. Despite the sexual dimorphism, common characters present in both sexes corroborate the hypothesis that the distinct forms are the same species, such as the red macules on the costal margin and on the tornus region, and tufts of red scales on the terminal portion of the abdomen (Moraes et al. 2017).

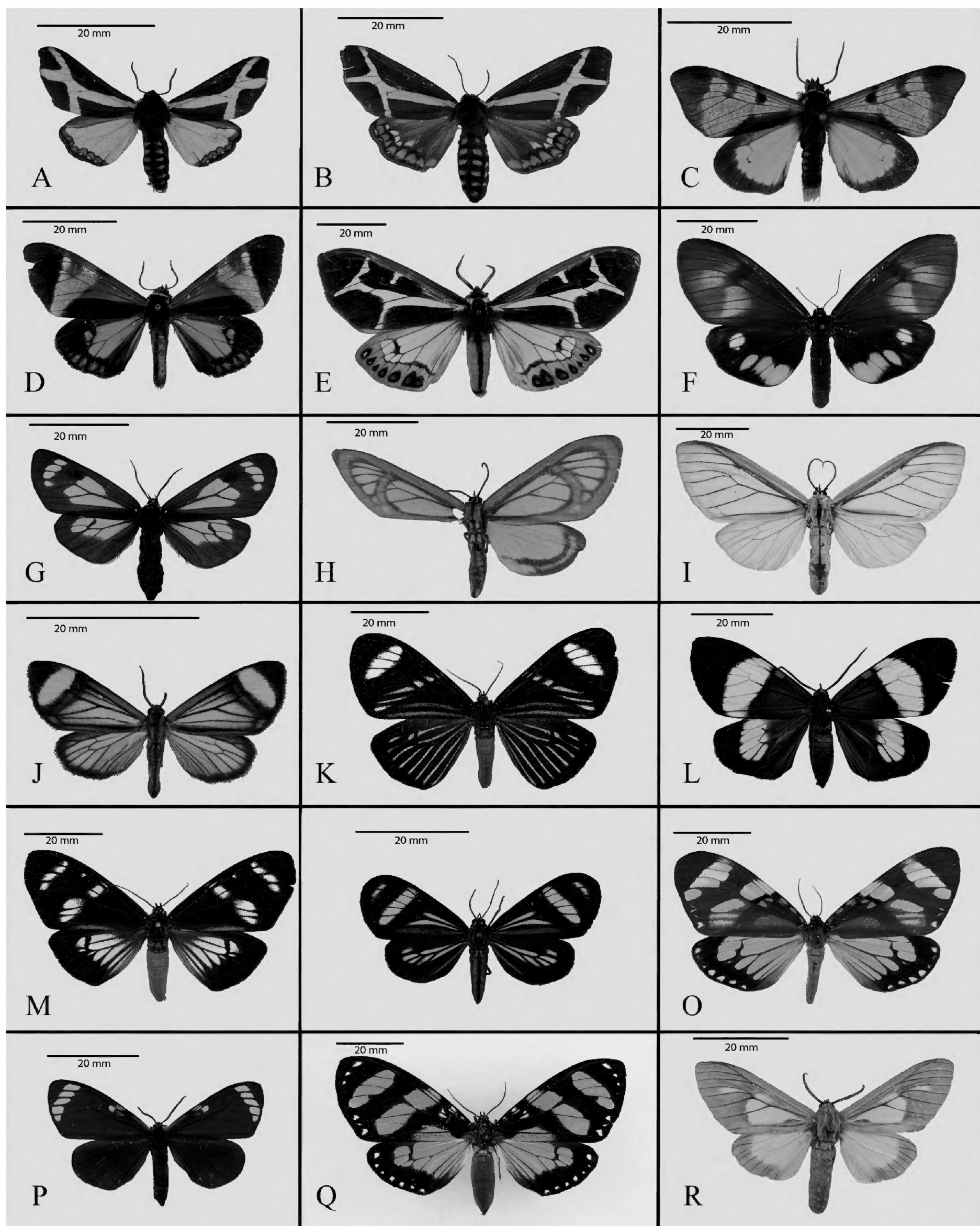
Males of *D. terminata* have wing pattern similar to that of *D. subapicalis*, differing from the last by the reduced “V” shaped semi hyaline region on the forewings, by the hindwing with a yellow discal region and veins outlined with dark brown scales, and an abdomen with two yellow bands ventrally. Males are also polychromatic on the hindwings, recorded by a series of specimens collected at the Boracéia Biological Station, in Salesópolis, showing the red submarginal band quite evident or gradually reduced until its complete absence.

**Material examined.** 3 males, Brazil, Santa Catarina, Hansa?; 1 male, Brazil.

***Dysschema thetis* (Klug, 1836)**

Fig. 2E

**Remarks.** Species sexually dimorphic for hindwing patterns. *Dysschema thetis* is easily distinguished from



**Figure 2.** Habitus of pericopine moths, dorsal view. **A.** *Dysschema sacrificia* (Hübner, [1831]), male (ZMH 0840050); **B.** *Dysschema sacrificia* (Hübner, [1831]), female (ZMH 0840050); **C.** *Dysschema subapicalis* (Walker, 1854), male (ZMH 0840052); **D.** *Dysschema terminata* (Guérin-Méneville, 1844), male (ZMH 0840042); **E.** *Dysschema thetis* (Klug, 1836), male (ZMH 0896500); **F.** *Dysschema tricolora* (Sulzer, 1776), female (ZMH 0840041); **G.** *Gnophaela vermiculata* (Grote [1864]) (ZMH 0840366); **H.** *Hyalurga fenestra* (Linnaeus, 1758), male (ZMH 0840057); **I.** *Hyalurga fenestrata* (Walker, 1855), female (ZMH 0861006); **J.** *Hyalurga sora* (Boisduval, 1870), male (ZMH -0840363); **K.** *Hypocrita fenestraria* (Fabricius, 1775) (ZMH 0840362); **L.** *Eucyane dejanira* (Druce, 1895) (ZMH 0840360); **M.** *Hypocrita plagifera* (C. Felder and R. Felder, 1862) (ZMH 0840361); **N.** *Isostola divisa* (Walker, 1854) (ZMH 0840364); **O.** *Phaloe cruenta* (Hübner, 1823) (ZMH 0840053); **P.** *Phaloesia saucia* Walker, 1854 (ZMH 0840365); **Q.** *Notophyson tiresias* (Cramer, 1776), female (ZMH 0840056); **R.** *Sthenognatha gentilis* (C. Felder and R. Felder, 1874) (ZMH 0896537).



other *Dysschema* species, by the beige tegula color pattern; the sickle-shaped semi-hyaline macula on the forewings, extending from the basal region to the outer margin; and submarginal stripe on the hindwings with a distal element formed by oval brown ocellar macules with bluish-white scales inside.

The species is distributed from Mexico to Costa Rica and has differences in specimen size, in the intensity of the blue and orange tones of the hindwing ocellar macules, and the intensity of the red colour on the abdomen. These differences allow the recognition of two subspecies: *D. thetis howardi*, restricted to the south of the USA and northern Mexico, and *D. thetis thetis*, distributed from southern Mexico to Costa Rica. Nevertheless, there are no discernible variations in the anatomical structure of the reproductive organs between the two subspecies. The species was recorded foraging on *Ageratina altissima* (L.) R. King and H. Rob. (Asteraceae) and on species of *Brickellia* Elliott (Asteraceae) in the wild (McFarland, 1961), and many other Asteraceae in captivity.

**Material examined.** 2 males, Mexico; 1 male, Mexico, Cordoba.

### *Dysschema tricolora* (Sulzer, 1776)

Fig. 2F

**Remarks.** Males and females are sexually dimorphic for wing patterns. Females show an aposematic pattern similar to that of butterflies of the genus *Parides* (Papilionidae; see for example Aiello and Brown 1988) and chromatic variation for the semi-hyaline macules on the forewings, forming clinal variation in which several forms are still recognized as valid species. The study of large series is needed to confirm the validity of these forms as distinct species or synonyms. Males have a semi-hyaline wing pattern, with little chromatic variation. Wing pattern suggests that this species participates in clearwing mimicry rings, including many species of Ithomiini (Nymphalidae) and other putative batesian mimics in the families Pieridae (e.g. *Dismorphia theucharila*), Riodinidae (e.g. *Ithomeis* spp. and *Ithomiola* spp.) and several other day flying moths. Both male and female genitalia have asymmetric structures, which is unusual for *Dysschema* species.

**Material examined.** 1 female, Colombia.

### *Eucyane* Hübner

#### *Eucyane dejanira* (Druce, 1895)

Fig. 2L

**Remarks.** This species does not exhibit sexual dimorphism. The available information is restricted to the original description and its inclusion in faunal survey lists. This species is documented within the Amazon biome. *Eucyane dejanira* was previously allocated in the genus *Hypocrita* and subsequently moved to *Eucyane* by Laguerre (2017) based on a maximum likelihood

analysis using CO1 gene. However, this taxonomic decision shall be taken with caution because (i) while CO1 is effective and species-level identification, the high mutation rate can make it challenging to compare sequences across very diverse taxa because when comparing distant lineages, similar nucleotide changes may occur independently in different lineages, leading to misleading phylogenetic relationships (ii) the taxonomic coverage used by Laguerre (2017) is narrow and should include more Pericopina genera.

For instance, Moraes et al. (2021) showed a phylogenetic hypothesis where the genus *Hypocrita* is polyphyletic consisting of two unrelated groups (i) *Hypocrita* “*sensu strictu*” phylogenetically close to *Netoche* (ii) the other clade represented by *E. temperata* is phylogenetically close to the genera *Ephestris* and *Thirgis*. A wider taxonomic sampling and the use of nuclear genes are needed to clarify the phylogenetic relationship and the taxonomic validity of the genera *Eucyane*, *Hypocrita*, *Chetone* and *Netoche*, mainly because the evolution of the colour pattern within these genera was driven by mimicry relationships.

**Material examined.** 1 male, Venezuela.

### *Gnophaela* Walker

#### *Gnophaela vermiculata* (Grote, [1864])

Fig. 2G

**Remarks.** This species shows no sexual dimorphism, and is distributed mainly in

North America. Immature stages were reared by Bruce (1888) and Whitehouse (1921) in *Mertensia virginica* (L.) Pers. ex Link, 1829. L’Empereur et al. (1989) recorded the presence of pyrrolizidine alkaloids in adults of *G. vermiculata*.

**Material examined.** 2 males, USA; 1 female, USA; 1 female Mexico.

### *Hyalurga* Hübner

#### *Hyalurga fenestra* (Linnaeus, 1758)

Fig. 2H

**Remarks.** This species is not sexually dimorphic. Information about it is limited to the original description and its presence in faunal survey lists.

**Material examined.** 1 male, Brazil, Minas Gerais, Marambaia.

#### *Hyalurga fenestrata* (Walker, 1855)

Fig. 2I

**Remarks.** Non-sexually dimorphic species. Information about it is limited to the original description and its presence in faunal survey lists.



**Material examined.** 1 male, Brazil, Santa Catarina, Hansa?; 1 female, Brazil, Santa Catarina, Hansa?

***Hyalurga sora* (Boisduval, 1870)**

Fig. 2J

**Remarks.** This species exhibits sexual dimorphism, with both males and females displaying semi-translucent wing patterns. This characteristic suggests that it may engage in mimicry with glasswing Ithomiini butterflies (Nymphalidae), potentially forming mimetic rings. The available information is restricted to the original description and its inclusion in faunal survey lists.

**Material examined.** 1 male, Guatemala; 1 female, Guatemala.

***Hypocrita* Hübner**

***Hypocrita fenestraria* (Fabricius, 1775)**

Fig. 2K

**Remarks.** This species does not exhibit sexual dimorphism. Despite its prevalence in collections, the available information on this species is restricted to the original description and its inclusion in faunal survey lists. This species exhibits a broad distribution, including documented occurrences in the Amazon and Atlantic Forest biomes.

**Material examined.** 1 male, Brazil, Rio Grande do Sul, Iguassu [Foz do Iguaçu]; 3 females, Brazil, Pará; 1 female, Brazil, Santa Catarina.

***Hypocrita plagifera* (C. Felder & R. Felder, 1862)**

Fig. 2M

**Remarks.** This species is not sexually dimorphic. Information about it is limited to the original description and its presence in faunal survey lists. The species has a widespread distribution, with records in the Amazon and Atlantic Forest biomes.

**Material examined.** 1 male, Brazil, Pará, Óbidos; 1 female, Brazil, Rio Grande do Sul, Iguassu [Foz do Iguaçu]; 1 male, Peru, Panguana; 1 female, Peru; 4 males, no locality.

***Isostola* Felder**

***Isostola divisa* (Walker, 1854)**

Fig. 2N

**Remarks.** This species does not exhibit sexual dimorphism. The wing pattern suggests that these moths participate in mimicry rings with glasswing Ithomiini butterflies (Nymphalidae). The available information is restricted to the original description and its inclusion in faunal survey lists. While this species is commonly found

in Central America and the Amazon biome, Ferro (2007) documented its presence in the Brazilian Cerrado.

**Material examined.** 1 male, Costa Rica, Guapiles.

***Phaloe* Guérin-Ménéville**

***Phaloe cruenta* (Hübner, 1823)**

Fig. 2O

**Remarks.** This species lacks sexual dimorphism and is highly prevalent in both collections and natural habitats. The species has a large distribution in South America, primarily found in the biomes of Atlantic Forest, Cerrado, and Pantanal (Brazilian wetlands). Additionally, it can also be found in eastern Bolivia, Uruguay, and north-eastern Argentina. The wing pattern is somewhat reminiscent of some Ithomiini butterflies in the genera *Dircenna* and *Epityches*, with which the species is sympatric in most of its distribution. Different larval host plants have been reported, for instance *Austro eupatorium inulifolium* (Kunth) R.M. King and H. Rob. (Biezanko et al. 1974) and *Artemisia absinthium* L. (Pastrana, 2004) (Asteraceae).

***Phaloesia* Walker**

***Phaloesia saucia* Walker, 1854**

Fig. 2P

**Remarks.** This species does not exhibit sexual dimorphism, and its extensive range spans from Southern USA and Mexico to South America, including Colombia and Venezuela. Consequently, other species were subsequently identified but ultimately determined to be synonymous. The wing pattern is similar to some species of Central American butterflies such as *Pheles melanchroia* (Riodinidae) and *Chlosyne ehrenbergii* (Nymphalidae), and to some extent to *Sthemopsis clonia* and *E. alicia* (Riodinidae), and so mimicry cannot be discarded.

**Material examined.** 1 Female, Mexico, Manzanillo.

***Netoche histrio* (C. Felder & Felder, 1874)**

Fig. 1D

**Remarks.** *Netoche histrio* lacks sexual dimorphism and exhibits a tiger-pattern imitation colouring resembling several species of tiger patterned butterflies in the genera *Heliconius* and *Eresia*, some tiger patterned Ithomiini (Nymphalidae), and some Riodinidae, such as *Stalachtis calliope*, all occurring in the Amazon. Polychromatism on the hindwings led to the description of several subspecies, but currently only three subspecies are recognized based on dissimilar geographical and altitudinal ranges (Lamas and Grados 1997; Lamas, 2017).

**Material examined.** 1 male, Brazil, Amazonas.

## *Notophyson Boisduval*

### *Notophyson tiresias* (Cramer, 1776)

Fig. 2Q

**Remarks.** This species does not exhibit sexual dimorphism. The presence of semi-translucent wing patterns suggests that this species engages in mimicry with other butterflies and moths, particularly some large Ithomiini in the genera *Methona* and *Dircenna* and the Danaini *Lycorea illione* (Nymphalidae). In the Amazon, this mimicry ring includes many other butterfly families, including Papilionidae (e.g. *Parides hahneli*) and Pieridae (e.g. *Patia orise*). The available information is restricted to the original description and its inclusion in faunal survey lists. The species exhibits a broad distribution, as evidenced by the description of the type species in the Amazon (Suriname) and documented occurrences in the Atlantic Forest.

**Material examined.** 1 male, Brazil, Rio de Janeiro; 1 female, Brazil, Rio de Janeiro.

## *Sthenognatha Felder*

### *Sthenognatha gentilis* (C. Felder & R. Felder, 1874)

Fig. 2R

**Remarks.** This species is sexually dimorphic, with females lacking the translucent macula on the forewing. Lane and Watson (1975), on a revision of genus *Sthenognatha*, provide some information on morphological traits. Other than that, information about this species is limited to the original description and its presence in faunal survey lists. The species has been recorded in the Atlantic Forest biome.

**Material examined.** 1 male, Brazil, Santa Catarina, New Bremen [Seara municipality]; 1 male, Brazil, Santa Catarina, Hansa?; 1 female, no locality.

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## Supplementary material 1

### Pericopina specimens deposited in the the Museum of Nature Hamburg

Authors: Simeão de Souza Moraes, André Victor Lucci Freitas, Karina Lucas Silva-Brandão

Data type: xlsx

Explanation note: Label data from specimens deposited in Hamburgt.

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